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Proposal to Develop a Detailed Safety Program for General/Laser Surgical Patients Infected With AIDS

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Medical health personnel have acquired serious and rarely fatal infections in the operating room from AIDS patients. Yet, there are no officially approved AIDS safety programs designed to protect medical health care personnel in the operating room. A sequential safety program is proposed beginning with the following steps: 1) evaluation and staging of the patient and associated complications; 2) protection of the major surgical and laser instruments; 3) use of an efficient evacuator system to avoid plumes of laser fragments from polluting the operating room environment; 4) protection of the operating room staff with special eye protection including helmets and shields, fluid-soak-resistant fabrics for garments, double surgical gloves, and special orderly trays with safety holders for syringes, needles, sharp instruments, and suture holders; 5) reporting and treatment of accidents, such as needlestick puncture wounds, that require immediate attention and an infectious disease consultation; 6) postoperative care, which includes providing medical health care personnel protection from bloody bandages, needles, and the infectious patient; and 7) and finally, the washing and sterilizing of contaminated instruments by medical health care personnel using face shields and masks, gloves, and protective fabrics for garments. Continued experience with this proposed safety program will determine its future value for AIDS surgical patients and for all health care workers. © 1996 Wiley-Liss, Inc.*

Key words: AIDS safety, lasers, AIDS, laser protective masks, shields and gloves

INTRODUCTION

Dr. King currently paints a very gloomy picture of the AIDS epidemic. He notes that since AIDS was identified more than a decade ago, the bad news continues to be bad, with a cure still not in sight. Even changes in behavior, which could hinder the spread of the epidemic, are slow, transient, and inconsistent. People are still afraid to openly confront and discuss this issue. Meanwhile, tens of thousands of people die, with millions of people at risk. Among those often at high risk are the surgeons who might acquire infections from patients in the operating room, especially from blood-borne diseases like AIDS and hepatitis B [1].

As presented by Rotheram in February 1994, the infectious hazard from blood-borne diseases can be the cause of "death" and should be highly considered for implementation in a definite "mandatory" safety program [2]. A *New York Times* article of September 23, 1994 by Tim Hilchey notes that a nurse in Iowa died at the age of 40

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from being infected with the AIDS virus in 1986 while treating a patient in the emergency room of Memorial Hospital in Prairie du Chien, Wisconsin. The patient died later and the autopsy showed that he had AIDS [3]. It is also noteworthy that in November 1985, a U.S. Navy hospital corpsman accidently punctured his fingertip while disposing of a phlebotomy needle. Two weeks after the needlestick accident, he learned that the patient had AIDS, and he had HIV antibody titers taken monthly for 3 months. All HIV antibody titers tested negative. In April 1986, he became sick with swollen neck glands, joint pains, and fever. In May 1986, he was diagnosed as HIV positive; the patient's wife tested negative [4]. This same patient subsequently died of AIDS in January 1994 (Wallace MR, personal communication, 1994).

In a recently published book on surgical problems in the AIDS patient, Fry notes that because of the accumulated risk of human immunodeficiency virus (HIV) and other viruses of occupational significance, health workers in the operating room environment must change their behavior [5]. From an infection control standpoint, Hardin and Nichols recognize that some past behaviors in operating rooms are no longer acceptable, and prevention and prophylaxis are paramount to the safety of all health care workers [6].

The Occupational Safety and Health Administration (OSHA) issued a series of regulations which incorporated the concept of universal precautions and controls as the standard of practice for all health care workers. OSHA ordered the implementation of these regulations in health care facilities across the nation [6,7]. However, they are general in nature and not specific to the new and important role of laser surgery and some of the other surgeries for the treatment of AIDS patients.

This proposed safety program offers specific details which contribute to greater understanding of the role of safety and protection in the operating room. It is not intended to induce hysteria but rather to highlight the increasing epidemic of AIDS and its consequent problems in surgery and in care of the AIDS patient for health care workers.

Among the various new surgical instruments in use today are lasers, which bring about unique safety needs. Lasers are being used to surgically treat AIDS patients with Kaposi's sarcoma of the skin, in the oral cavity, and in the colon.

For AIDS surgery the proposed safety sequence includes 1) the surgical staff being informed about the stage of AIDS and the particular hazards of the individual patient, the potential complications of surgery, the presence or absence of pneumonitis, and the use of local or general anesthesia; 2) protection being provided from contamination of special instruments—such as the laser; 3) the evaluation of the efficacy of the evacuation system, electrosurgery as regards smoke and viable fragments; 4) protection of surgeons and other surgical (circulating) personnel with special gloves, masks, and shields, helmets with internal air flow, additional eye protection with laser glasses, and skin-barrier operating gowns; 5) special attention being given to the careful arrangement and holders for syringes, needles, and sharps; 6) provisions for the special needs of recovery room staff and for sterile processing staff who clean and sterilize contaminated instruments; and 7) prevention, reporting, and treatment of accidents. A copy of a complete safety program should be posted in the operating room for special attention by all health care workers (Table 1).

SEQUENTIAL PROTECTION FOR INSTRUMENTATION AND SURGERY

Laser Protection

Recent concerns have been expressed regarding greater liability from the Q-switched lasers, with which viable fragments, rather than heat-affected fragments, are formed into plume fragments. The plastic cone used on the laser head, as we used in the early days of laser surgery, are useful for Q-switched and for other laser surgery today. The outer rim of the plastic cone rests tightly about the target area, preventing plume fragments from spreading and even impacting the lens system in the laser [8A]. For good protection of the face in AIDS surgery, plastic shields should be used, or even better, the Stackhouse helmet (Fig. 1) (Stackhouse Inc., Riverside, CA) and Vigilon (Bernesco, Seattle, WA) as Kilmer suggested [8]. This is an occlusive hydrogel which covers the local lesion during laser surgery and holds the fragments. Contamination may be related to the fiberoptics. Varied endoscope covers should be used to prevent contamination (Fig. 2), and even the operating instruments may be contaminated. Fluorescein may be used to study plume patterns. Wood et al. have reported that reflections of the laser from highly

TABLE 1. Outline of a Sequential Safety Program for AIDS Surgery*

1. The staging of the AIDS patient (especially in regard to infectious lesions and *Pneumocystic carinii* pneumonia)
2. Protection from contamination of special instrumentation
   a. Lasers
      i. Effective plume evacuation system
      ii. Plastic cone cover over exit area of laser head, and
      iii. Vigilon cover over accessible target areas for Q-switch lasers
   b. Endoscopes: removable protective cover
3. Plume evacuator system to avoid air pollution from lasers and electrocoagulation needle fragments; the fresh filter system is considered a postoperative biohazard
4. Head helmets with internal air flow, or respirator having a face shield and protective glasses to avoid eye splash; for laser surgery use specific laser protective glasses and laser protective mask.
5. Special surgical protective gloves, or double or triple powderless surgical gloves
6. Needlestick prevention: Use special needles and a special display tray for the needles and syringes, suture holders and sharp instruments
7. Special skin barrier gown for protection from blood and fluid pressure soaking
8. Electrical check of surgical gloves at intervals for any perforations
9. Personnel safety programs for postoperative patient care and instrument cleaning
10. Accidents: initial report, examination, treatment, and immediate consultation with infectious disease staff, follow-up examinations, and final report

*Post in operating room. Some patients may be highly suspected of infection with AIDS but not proven. So, it is important, first, to stage the patient for AIDS.

polished instruments can cause burns [9]. Laser instruments and also the plastic cone should be cleaned after each operation.

The Evacuator System

The operating room must be properly ventilated, and the suction efficiency of the evacuator system (Fig. 3) must be adequate [10,11]. The filters (charcoal or Hepa type) should be fresh and adequate. Some filters have antimicrobial and even antiviral properties. All filters are considered biohazards after use and should be treated appropriately. The suction tip of the evacuator should be at least 2 cm from the target to attempt to get maximum suction for the particles in the filters down to 0.01 μm. There may also be toxic chemical compounds [10], heavy metal particles, or even gases in the atmosphere. Electrosurgical units may also produce bloodied plume fragments. Therefore, a regular check of the filter is mandatory [12]. It is also the duty of the laser safety officer to establish a constant vigil regarding safety for non-laser hazards such as electrical hazards, flammable operating room drapes, improper ventilation, and an inefficiently operating evacuator [11].

The Surgeon

The protection of the surgeon in AIDS surgery is of the utmost importance. The surgical specialties vary in their presumed hazards of AIDS surgery; however, all surgery must first be considered in light of the OSHA Universal Standards for blood-borne pathogens in all patients [7]. Particular emphasis lies in the hazardous surgical fields of obstetrics, orthopedics, and urology, dentistry, dermatology, and plastic surgery. Varied phases of safety programs for laser surgeries for AIDS patients include laser eye protection for surgeon and patient (Fig. 4), respiratory protection from air pollution, protective surgical (double) gloves, protective cap and gown clothing of special fabrics resistant to fluid pressures and blood soakings, drapes around the operating field for protection from flammability, safe display of needles and sharp cutting surgical instruments, and special precautions during "no-touch" suture closures.

The surgeon must be protected from head to toe. We believe that especially with surgical AIDS patients, the Stackhouse helmet and its internal air flow provides effective protection, and in spite of its appearance, the entire makeup is not too uncomfortable to wear. If the Stackhouse helmet is not available, then the surgeon and the operating room personnel must use a face mask and shield with a good snug fit around the nose for maximum particle protection of 0.1 μm. If the mask and shield become damp, a fresh mask and shield should be used. During some surgical procedures, pervasive fluid soaking of surgical clothing and especially gloves require the use of special protectant skin-barrier fabrics.

Three fabrics that are being tested are Compel XTR (Standard Textiles, Inc., Cincinnati, OH), PRO/VENT (Kappler Safety Group, Guntersville, AL), and Angelica ASEP™ (St. Louis, MO). PRO/VENT, which was thinner, showed good results in preliminary safety testing for gloves. Another glove that was covered with a protectant and used

Fig. 1. Stackhouse protective helmet with internal air flow and laser protective glasses.

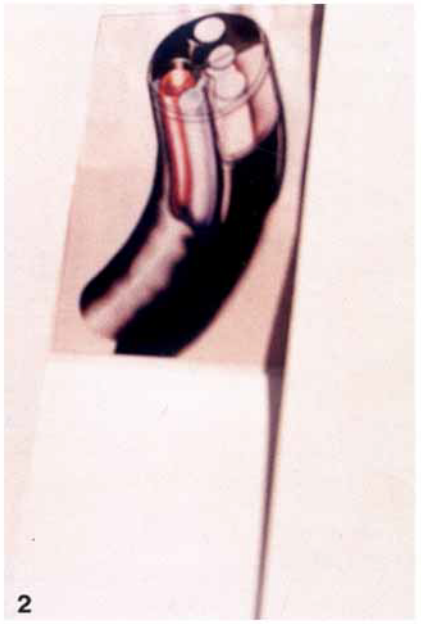


Fig. 2. Cross section of a type of cover for an endoscope used for AIDS patients or for patients with hepatitis B infection.

Fig. 3. Effective evacuator ring of Schultz (current developments will make it nonflammable).

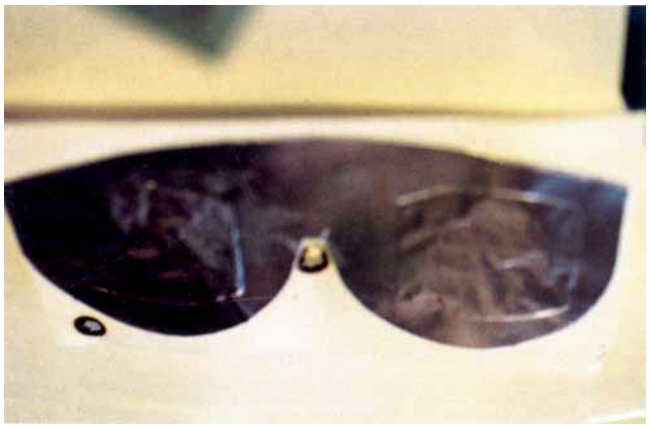


Fig. 4. Universal protective eye cover for patient. Superficial non-penetrating burns from a 15-W CO_2 laser on an eye shield with padded eye covers on the inside. Control deep burn on clear plastic below eye shield on the left.

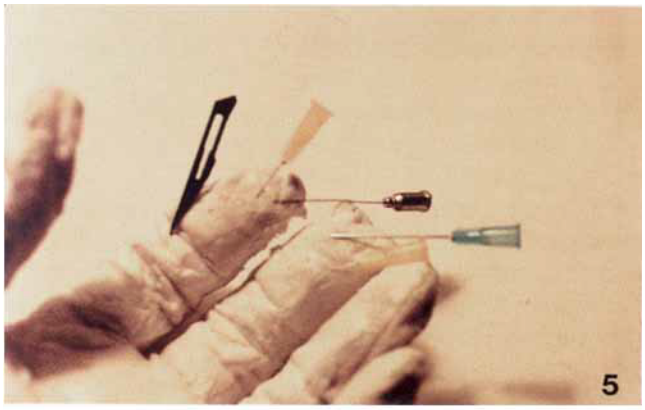
as a control is the Nitrile-NDEX™, which offers some resistance protection as well as flexibility.

In the absence of such protective fabrics, a double gown with double sleeves is recommended. When using a multiwave laser system, a change to laser protective glasses must be performed by all personnel in the operating room. This should be the responsibility of the laser safety officer.

Special Protective Surgical Gloves

The most common route of occupational HIV transmission for a health care provider is a self-inflicted needlestick with a contaminated needle (Robinson JK, personal communication, 1994). Additionally, in a recent Federal Drug Administration alert from James S. Benson (former director of the Center for Devices and Radiological Health) there is a much greater risk (up to six times greater) of needlestick puncture from hypodermic needles used as a connection between two pieces of intravenous equipment than from needles from a disposable syringe. The infectivity of the blood in a needlestick injury is related more to the titer of the virus rather than to the volume of the blood.

The ideal protective glove must resist needle puncture, cuts from sharp instruments, and fragments of bone (Fig. 5) [13]. Laser surgeons must be aware of the laser's capability to burn holes into the glove and consequently to burn the skin. However, the most difficult protection to obtain is protection against puncture. There is a movement at present to make needles blunt, especially in the area of gynecology (Reed K, M.D., personal communication, 1994). Research on the development of a universal protective glove continues.



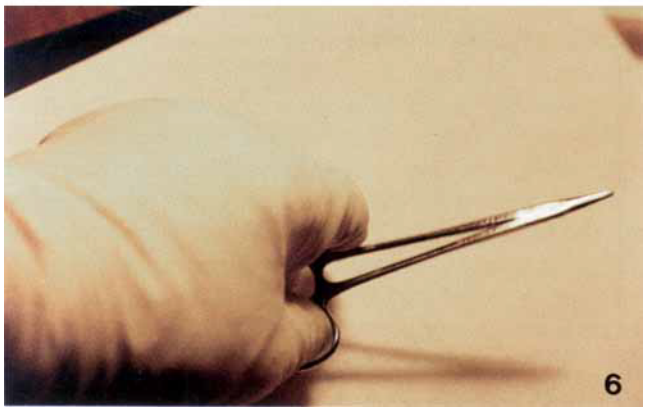


Fig. 5. Testing of under-glove for resistance to needle punctures, cutting, and even to 15-W CO_2 laser impact burns. The under-glove is covered with protectant emulsion.

Fig. 6. Initial experimental universal protectant glove in combination with an underliner protectant glove covered with a surgical glove. If a double surgical glove is used for protection, the under-glove may be covered first with the protectant emulsion to increase resistance to needle puncture, cuts, and burns.

Some gloves are dye incorporated, and when the glove is punctured, a large glob of dye immediately appears to warn the person wearing the glove. These gloves are to be removed instantly and the puncture investigated under magnification. A wash of the spot with hydrogen peroxide may detect a small bubble. The site is watched to determine whether any additional treatment is needed, and new gloves are then used (Fay M, R.N., Ph.D., personal communication, 1994).

Sometimes electronic devices are available to detect punctures in the gloves; this test can be done before or during the course of an operation. The special glove must not be too uncomfortable for surgical procedures or contain sensitizing materials. Latex gloves can be used if the protein levels for sensitization are markedly reduced to make the gloves hypoallergenic. Synthetic rubber gloves are available and include vinyl, synthetic elastomer, and Tactyl from tactylon (Fisher E, M.D., personal communication, 1994); powder-free gloves (without talc or corn starch) are preferred.

In order to develop a protective surgical glove against contamination by AIDS and similar blood-borne viruses, the following qualifications must be considered: 1) good fabric of at least a close knit variety, 2) prevention from fluid soaking, 3) fashioning into a full-finger glove—not the flat type, usually initial size 8, 4) thickness—the surgical use of the glove will be determined by the amount of dipping into a protectant mixture, e.g., thinner gloves for venipuncture use and thicker gloves for orthopedic and similar procedures, 5) soak protection, which comes from immersion in fluid containing 20 g of calcium carbonate crystals, USP, mixed well in 30 cc of Tachy glue (Allene's Division of Arts Inc., Buelleton, CA) and then thorough drying so that no crystal or powder remains, 6) sterilization of the glove by steam or by gamma radiation, 7) shipment of sterile packets of gloves with the full fingers stretched out with cardboard inserts, 8) thorough drying of gloves after use, inspection, and re-sterilization, and 9) thorough rinsing of hands and, while they are still wet, rubbing well with Aquaphor and drying completely.

In our research and development for special surgical gloves, we have used various types of protectants, such as a protectant emulsion made of a flexible glue with crystalline materials, to accommodate the dexterity of the surgeon. The thickness of the protective glove plus an underliner or overliner glove (Fig. 6) must not be too cumbersome. For the heavy work of orthopedic surgery, the protectant layer should be 1–1.5 mm thick. The current surgical cut-proof gloves are not universally puncture resistant for the entire glove. However, there are industrial protective gloves that are completely puncture resistant, and also resistant to cutting, electric-needle burn, CO_2 20 W, and deep burns (Fig. 7). To avoid hand irritation, at the completion of the operation the hands are to be rinsed well and covered with thin layers of Aquaphor creme and then wiped dry.

Operating Room Instruments

The importance of avoiding contaminated needles has been emphasized. All needles and syringes and sharp surgical instruments should be positioned in special containers so that there is

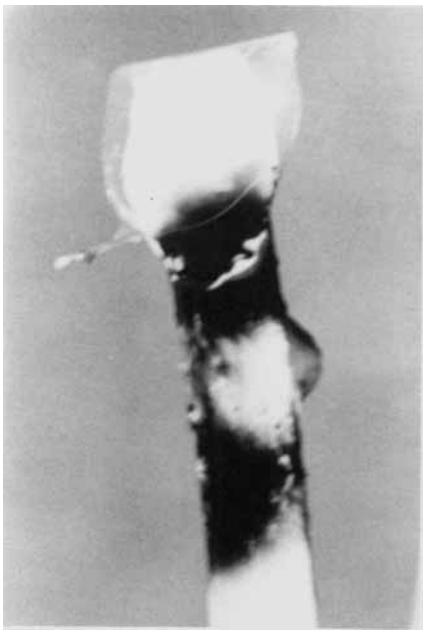


Fig. 7. Demonstrates burn resistance to 20-W CO_2 laser on the protectant glove covering.

utmost care in handling them, even with protective gloves (Fig. 8A–C). The organized arrangement of syringes and needles in containers before use and their safe and quick disposal after use into puncture-proof containers will avoid serious punctures [13]. When it is necessary to recap a syringe, do not hold the syringe, lay the needle and the syringe on a flat sterile area, and move the syringe up to the needle hub. For used needles (i.e., after an intravenous injection), put them in a pin cushion-type jar and secure the cover. The TS Turtle™ Syringe (Kershenstine Medical Inc., Metaire, LA), a spring-loaded plastic covered syringe, provides good needlestick protection; a cover springs over the needle after injection for disposal. However, if you are careless in handling this syringe, you can get a deep puncture. No-touch needle suture techniques can also be used to avoid needlestick injuries (Robinson JK, personal communication, 1994).

There are a variety of contamination problems that could arise in the operating room, including electrosurgical (needle) units (Fig. 9) if used without cover or sheath [9], fiberoptics in tissue [14], endoscopes that are not covered (Fig. 2), risky local therapies for Kaposi's sarcoma [15], pollution from infected lesions, and flammable surgical drapes. If separate laser operating rooms are not available to the surgeon, special laser protective curtains hung on stands or from the ceiling are available commercially.

Accidents

Accidents that occur either during laser surgery or general AIDS surgery should be immediately reported and treated. Cleanse the affected area gently, irrigate with peroxide or Dakin's solution, then first apply an antibacterial agent and later a topical antiviral agent. For eye contamination, which sometimes happens in spite of the protective eye glasses, irrigate freely and repeatedly, then have an ophthalmologist recommend treatment. If possible, a consultation with an infectious disease specialist should follow for all accidents.

Postoperative Patient Care

When caring for AIDS patients who have bloody bandages, always use the double-glove standard. Especially be concerned for continued oozing through dressings and contamination of pillows, sheets, and bed covers. If topical or irritant chemotherapeutic agents are used, there is a danger of acquiring secondary infectious lesions on the skin [16].

Cleaning Instruments

To protect personnel cleaning contaminated surgical instruments used in AIDS surgery, use the double-layer glove technique, wear protective gowns and an effective protective mask with a face shield used over the mask (to allow for brush splatter), and use 0.5% sodium hypochlorite solution to decontaminate the instruments before the sterilization techniques are started. Ascertain that syringes and needles are put into disposable, stick-proof, biohazard containers [17].

CONCLUSIONS

This proposed comprehensive safety program for surgery of AIDS patients and other blood-borne diseases should be followed whether or not lasers are used. Recommended for posting, Table 1 outlines a sequential safety program for AIDS surgery starting with the staging of the AIDS patient, protection of the laser from contamination, use of protective coverings for endoscopes and fiberoptics, use of air evacuator for laser plume fragments and multiwave length systems which can cause air pollution, awareness of electrical and fluid hazards, use of protective wear for surgical personnel, special coverings for

Fig. 8. Types of orderly, safe displays of hazardous instruments in the operating room. **A:** Box display by Preven-A-Stik (Preven-A-Stik Inc., Houston, TX) suture holder for syringes, needles, and sharp instruments. **B:** Pin cushions for discarded needles—before using nonpenetrating biohazard holder. **C:** Type of protectant needle—TS-1 Turtle Syringe.

equipment, care of the postoperative patient, and prevention and reporting of accidental injuries. When it is necessary to operate on an AIDS patient, special safety precautions must be taken by the surgeons and all health care workers to avoid the hazards of this infection. With a good safety

Fig. 9. Type of plastic cover for electric needle to reduce particle tissue dispersion after electrosurgery. A sharp electric needle point may penetrate the usual surgical glove but not the special universal protective glove. The electric spark is nonconductive through the intact surgical glove.

program in place, even the laser surgery of cutaneous or visceral Kaposi's sarcoma can be accomplished safely and effectively.

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